

Concentration

Learning Objectives

1. What is concentration?
2. Percent (m/v, v/v...)
3. Molarity
4. Parts per million/billion



Concentration is a measurement of how much stuff you have in a given volume

The more stuff you have (or less volume), the higher the concentration



Percent (m/m, m/v, v/v)

$$\frac{\text{part}}{\text{whole}} \times 100$$

A 30g solution of NaCl (aq) is evaporated and found to contain 2g of NaCl. What is the percent by mass of NaCl in this solution?

$$\frac{\text{PART}}{\text{WHOLE}} =$$

$$6.66\% \text{ m/m}$$

$$12\% \text{ v/v}$$

What is the volume of ethanol in a standard 750mL bottle of red wine?

$$\frac{x \text{ mL}}{750 \text{ mL}} =$$

✓✓



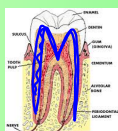
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Molarity

$$\frac{\text{mol}}{\text{L}} = M$$

Molarity = $\frac{\text{Mols of solute}}{\text{Litres of Solution}}$



What is the molarity of 2 moles of NaOH in 1L of solution?

What is the molarity of 0.5 moles of KNO_3 in 100mL of solution?

$$\frac{0.5 \text{ mol}}{100 \text{ mL}} = 5 \text{ M}$$

What is the molarity of 60g of NaOH in 1L of solution?

$$\frac{60 \text{ g}}{23+16+1} \Rightarrow 1 \text{ M}$$

mass
of moles
molar mass

Molarity is the concentration type of choice is the chemist world. When asked to make up a solution of NaOH, a chemist should ask...how strong do you want it....or what molarity do you need....2M, 6M?

To calculate how much solute you need to make the solution required:

How many grams of KOH are needed to make a 4L of a 0.5M KOH solution?

$$C = \frac{n}{V} \Rightarrow 0.5 \text{ M} = \frac{n}{4 \text{ L}}$$

$$n = 2 \text{ mol}$$

$$g \text{ KOH} = 2 \text{ mol} \times (39 \text{ g/mol} + 16 \text{ g/mol} + 1 \text{ g/mol})$$



$$= 112 \text{ g of KOH}$$

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How Do You Dilute a Concentrated 12M solution of HCl?

Acid is more dense than water and the reaction is highly exothermic. Therefore, it is necessary when diluting to add the acid to the water so it can move slowly to the bottom, dissolving as it goes.

The formula for molar conc is $c = n/V$. When diluting a solution, the number of moles doesn't change so you can use the following to denote the relationship between molar concentration of concentrated solution and dilute solution

$$c_1V_1 = c_2V_2$$

Problem: Your teacher has a stock solution of 12M HCl. A class experiment requires 2.0L of 0.10M HCl. What volume of conc solution should be used to make the dilute solution for the experiment?

Parts per Million (ppm)

Just like percent m/m but instead of writing out of 100, you write it out of one million

This is particularly useful when talking about small amounts of solute ions in a solution. It is used mostly for talking about contamination levels and safety guidelines

Parts per Million	$\frac{\text{grams of solute}}{\text{grams of solution}} \times 10^6$
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What is the concentration in ppm of lead ions in 100g of tap water with 0.0000350g of lead ions dissolved in it? Is that safe according to Government Canada limits?

$$\text{ppm} = \frac{0.0000350\text{g} \times 10^6}{100\text{g}} = \text{ppm}$$



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Review Practice

Turn to page 309 in your textbook and answer questions # 1 - 10

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